IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

Angelopoulos et al.

Date: June 8, 2001

Serial No.: 09/256,034

Group Art Unit: 1752

Filed: February 23, 1999

Examiner: J. Chu

For: MULTILAYERED RESIST SYSTEMS USING TUNED POLYMER FILMS AS UNDERLAYERS AND METHODS OF FABRICATION THEREOF

Assistant Commissioner for Patents
Washington, D.C. 20231

APPEAL TO THE BOARD OF APPEALS AND INTERFERENCES

Sir:

Applicants hereby appeal the Examiner's final rejection of Claims 1-8, 18 and 19 as set forth in the Office Action dated November 17, 2000. Pursuant to 37 C.F.R. 1.192(c), applicants submit the following brief in support of the patentability of pending Claims 1-8 and 18. Applicants request Oral Hearing.

1) REAL PARTY IN INTEREST

The above-identified patent application has been assigned to the International Business Machines Corporation. The assignment has been recorded in the U.S. Patent and Trademark Office: Recordation date April 16, 1999; Reel/Frame 9931/0660.

RELATED APPEALS AND INTERFERENCES

There are no related appeals and interferences.

STATUS OF CLAIMS

Claims 1-18 were initially filed in this application. Claims 1-8, 18 and 19 are presently pending therein. Typographical errors are corrected in claims 1, 2 and 18, and claim 19 is added in the Amendment filed with this Appeal. Claims 9-17 were withdrawn as being directed to a non-elected invention. The final rejection of claims 1-8, 18 and 19 provides the basis for this appeal. Claims 1, 18 and 19 are independent claims.

STATUS OF AMENDMENTS

On May 15, 2001, applicants filed a timely Notice of Appeal subsequent to the final rejection dated November 17, 2000. Changes have been made to the claims by Amendment filed with this Appeal Brief to correct typographical errors.

SUMMARY OF THE INVENTION

A broad aspect of the present invention is a multilayer resist system and method of fabrication thereof.

A more specific aspect of the present invention is a multilayer resist system in which a thin resist is patterned on top of a thicker underlayer; optical, chemical, and physical properties of the underlayer are appropriately tuned to result in a multilayer resist structure exhibiting sub 200nm resolution.

Another more specific aspect of the present invention is a multilayer resist system in which the optical, chemical, and physical properties of the underlayer are controlled to prevent interfacial mixing with the resist, interfacial reaction, and diffusion of components from one layer into another.

Another more specific aspect of the present invention are methods of tuning the optical properties such as index of refraction (n) and extinction coefficient (k) of the underlayer at a given optical wavelength including 365 nm, 248, 193, 157nm and EUV.

Another more specific aspect of the present invention are methods of fabricating underlayers with suitable optical, chemical, and physical properties to be used as thick anti-reflective coating in a multilayer resist structure, said properties being tailored by controlling bake temperature, bake time, bake environment, bake type, chemical composition of underlayer, exposure to radiation including optical, x-ray, electron beam and ion beam.

Another more specific aspect of the present invention are methods of tuning the index of refraction *n* and extinction coefficient *k* from about 1.45 to about 2.1 and about 0.01 to about 0.6, respectively, at 365, 248, 193 and 157nm.

Another more specific aspect of the present invention is a method according to the crosslinking is dependent on the processing conditions- bake, temperature, time as well as the formulation of underlayer - i.e. the crosslinker that is put into the formulation, and the amount of crosslinker. The method is a combination of designed formulation and processing conditions. If the underlayer is not appropriately designed significant residue occurs sometimes even in the larger features due to (1) interfacial mixing of resist and underlayer (2) diffusion of acid or other components of the resist into underlayer and (3) potential outgassing of components from underlayer into resist.

ISSUES

1) Are claims 1-8, 18 and 19 anticipated under 35 USC 102(e) over Allen et al.?

GROUPING OF THE CLAIMS

The claims are grouped as follows:

Group I	Claims 1-6, 19
Group II	Claim 7
Group III	Claim 8
Group IV	Claim 18

GENERAL ARGUMENT

Claims 1-8, 18 and 19 have been rejected under 35 USC 102(e) over Allen et al. Allen et al. is not a reference under 35 USC 102(e) since it teaches away from applicants claimed invention. Applicants' Figure 10(b) shows a structure formed by the type of process described in Allen et al., Example V. Applicants' Figure 10(a) is an example of Applicants' claimed structure which shows the effect of the last clause of Applicants' claim 1. The teaching of Allen et al. cannot result in the recitation of the last clause of Applicants' claim 1. This or similar recitations is in all of Applicants' claims. The Board's attention is directed to Applicants' example 6 at page 24-25 of the specification which describes Figure 10. Thus, applicants claims 1-8 and 18 cannot be anticipated by Allen et al.

The Examiner states in the continuation sheet of the Advisory Action dated 5-11-01, that Applicants' Amendment After Final Rejection:

> ... does NOT place the application in condition for allowance because: It is not clear that the prior art material of ALLEN ET AL. does not anticipate the claim 1 wherein the layers do not substantially intermix. The evidence of record relies on the terms "significant" v. "not significant" to distinguish the prior art from the invention. More physical evidence is needed to establish that the intermixing is actually significant in the prior art, i.e. the weight of the evidence is lacking.

The Examiner states more physical evidence is required. The specification states from the last two lines on page 24 to line 4, page 25, "Fig.10(b) shows resist profiles on non tuned conventional Shipley novolac/diazonapthoquinone resist SPR 501 used as an underlayer. Although novolac/diazonapthoquinone resist SPR 501 was hard baked to suitably cross-linked the material to prevent interfacial mixing with the resist, significant residue was observed. Resolution of 150nm and below can not be attained with conventional novolac/diazonapthoquinone resists."

Allen Example V teaches using Shipley 510L novolac resist which is a conventional novolac resist which Applicants Example on pages 24-25 shows does not work. This is sufficient physical evidence to overcome the rejection, under 35 USC 102(e) as anticipated by Allen et al.. There is no teaching or suggestion in Allen of Applicant's claimed invention. Allen teaches away from Applicants' claimed invention. All of Applicants' claims recite "said layer of material having a crosslink density sufficiently high that said layer of material and said resist do not substantially intermix". At col. 4, lines 2-3, Allen teaches that crosslinking of the bottom layer is "optional". All Applicants' claims require crosslinking of the bottom layer to be sufficiently high that the layer or material and the resist do not substantially intermix. Allen clearly does not teach or suggest this. Thus, Allen cannot anticipate any of Applicants' claims.

SPECIFIC ARGUMENTS TO GROUPING OF CLAIMS

Group I - Allen has no teaching or suggestion to control crosslink density.

Group II - Allen has no teaching or suggestion of extinction coefficient or index of refraction.

Group III - Allen has no teaching or suggestion of feature size.

Group IV - Allen has no teaching or suggestion of controlling crosslink density by the claimed process parameters.

CONCLUSION

Applicants request the Board to reverse the Examiner's rejection of claims 1-8, 18 and 19 rejected under 35 USC 102(e) as being unpatentable over Allen et al.

Please charge any fee necessary to enter this paper and any previous paper to deposit account 09-0468.

Respectfully submitted,

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APPENDIX

1. A method comprising:

disposing on a surface a layer of material;

disposing in said layer of material a resist material;

said layer of material having a crosslink density sufficiently high that said layer of material and said resist do not substantially intermix.

2. A method according to claim 1, wherein said layer of material is a novolak.

3. A method according to claim 1, wherein said material is selected from the group consisting of novolac/diazonapthoquinone resists, polysulfones, polyhudroxy styrene bases materials, polyimade materials cast from solvents containing no amines.

4. A method according to claim 1, wherein said resist is exposed to energy to form a pattern in said resist.

5. A method according to claim 4, wherein said energy is a beam selected from the group consisting of electromagnetic radiation and a particle beam.

6. A method according to claim 5, wherein said particle beam is an electron beam.

7. A method according to claim 1, wherein said material has an index of refraction from about 1.4 to about 2.1 and an extinction coefficient from about 0.1 to 0.6 at 365, 248, 193 and 157 nm.

8. A method according to claim 1 further including forming a pattern in said resist material, developing said pattern to form a sub 200 nm feature in said layer of material.

18. A method according to claim 1 wherein said crosslink density is dependent on processing conditions selected from the group consisting of bake, temperature, time, the formulation of said layer of material.

19. A method comprising:

disposing on a surface of an electronic device a novolak material;

curing said material to a predetermined degree of crosslinking;

disposing on said novolak material a resist material, said degree of crosslinking being sufficient to substantially prevent said resist material from intermixing with said novolak material;

exposing said resist to a pattern of energy selected from the group consisting of electromagnetic radiation and a particle beam to form a pattern of exposed and unexposed regions in said resist;

developing said pattern to remove either said exposed or said unexposed regions of said resist to expose said layer of material where said resist in removed;

removing said layer of material where said resist is removed to leave on said electronic device a bilayer of said novolak material and said resist having a pattern therein having regions within which said surface of said electronic device is exposed.